CONCEPTUAL MITIGATION PLAN PROPOSAL

TERMINAL 4 EARLY ACTION
PORT OF PORTLAND, PORTLAND, OREGON

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Prepared for
Port of Portland

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1 INTRODUCTION

This document presents a Conceptual Mitigation Plan Proposal (CMPP) to address requirements of the Clean Water Act (CWA) Section 404(b)(1) (40 CFR 230 [2001]) that arise because of activities associated with the Non-Time Critical Removal Action (Removal Action) ordered by the United States Environmental Protection Agency (USEPA) at the Port of Portland's (Port) Terminal 4 facility in Portland, Oregon.

In 2000, the USEPA added the Portland Harbor Superfund Site (Superfund Site or Site) to the National Priorities List (NPL) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, 42 U.S.C. § 9601, et seq. The Superfund Site Initial Study Area (ISA) encompasses about 6 miles of the Willamette River in Portland, Oregon and includes the Terminal 4 facility. A vicinity map and aerial of the Terminal 4 facility are shown on Figure 1. The Port owns Terminal 4 and leases land there to several marine tenants.

In fall 2001, the USEPA and 10 of the Superfund Site's potentially responsible parties entered into an Administrative Order on Consent (AOC) a Remedial Investigation/Feasibility Study (RI/FS) of the Superfund Site, CERLCA-10-2001-240 (USEPA 2001). The AOC allows Early Removal Actions to be conducted to address known contamination at specific locations within the Superfund Site. Contaminants found in Terminal 4 sediment samples during a RI directed by the Oregon Department of Environmental Quality (DEQ) led to a determination that a Removal Action at Terminal 4 is warranted. Accordingly, the Port is conducting a Non-Time-Critical Removal Action (NTCRA) under an AOC for Removal Action, CERCLA 10-2004-0009, executed by the Port and USEPA in October 2003 (USEPA 2003).

As required by the AOC and attached Statement of Work (SOW), the Port conducted a site characterization and evaluated potential Removal Action alternatives necessary to protect human health and the environment. Four Removal Action alternatives were identified, described, and evaluated in the engineering evaluation/cost analysis (EE/CA) (BBL 2004a and 2004b) in accordance with USEPA NTCRA evaluation criteria. USEPA issued the Action Memorandum on May 11, 2006 (USEPA 2006) and documented their clean up decision for the Removal Action (Figure 2).

The Removal Action includes a combination of remedial technologies, including discharge of fill material for capping contaminated sediments, dredging contaminated sediments, and monitored natural recovery (MNR). The Removal Action also includes construction of a confined disposal facility (CDF) in Slip 1. Construction of the CDF will require discharge of fill materials into Slip 1 to construct containment components, and discharge of contaminated dredged sediments into the CDF for final isolation. Discharge of the fill materials for capping and for the CDF results in a requirement for USEPA to evaluate the action based on guidelines in the CWA Section 404(b)(1) and triggers the need for compensatory mitigation due to loss of aquatic habitat. This document represents the initial step in identification and documentation of compensatory mitigation activities proposed by the Port.

The remainder of this document provides the following information related to developing mitigation options to replace habitat lost due to the Removal Action:

- Section 2 – Background Information describes the purpose and need for the Removal Action, Removal Action activities requiring mitigation, and a process for selecting a mitigation project.
- Section 3 – Habitat Assessment summarizes the methods and results of a habitat assessment conducted at Terminal 4 to characterize the habitat and determine habitat functions that will be lost due to the Removal Action.
- Section 4 – Overall Mitigation Approach describes the Port's approach to mitigation, specific criteria for identifying mitigation projects, and established Lower Willamette River mitigation/restoration strategies.
- Section 5 – Mitigation Options and Feasibility identifies a range of conceptual mitigation options that the Port is exploring that will adequately offset habitat losses resulting from the Removal Action based on the information provided in Sections 2 through 4.
- Section 6 – Summary of Mitigation Options and Next Steps summarizes the process for identifying a mitigation project based on the feasibility evaluation in Section 5 and consistency of each proposed option with selection criteria described in Section 4.

2 BACKGROUND INFORMATION

2.1 Purpose and Need for Removal Action

The need for the proposed action is based on the presence of contaminated sediments in the Portland Harbor Superfund Site and, specifically, the Terminal 4 Removal Action Area. In some areas of the Terminal 4 Removal Action Area, concentrations of the contaminants exceed sediment quality guidelines (SQGs) that represent concentrations at which sediments may be toxic to benthic organisms that live in the sediments and experience direct exposure to contaminated sediments. Other forms of aquatic life, avian and mammalian wildlife, and humans may be indirectly exposed to sediment contaminants if they eat biota that have become contaminated from Removal Action Area sediments. As a result of the contaminated sediments, the need for a NTCRA was identified and the EE/CA was performed.

Removal Action Objectives (RAOs) identified for the Removal Action Area are to:

- Reduce ecological and human health risks associated with sediment contamination within the Removal Action Area to acceptable levels
- Reduce the likelihood of recontamination of sediments within the Removal Action Area

The proposed action must also be considered in the context of the overall Superfund Site. USEPA guidance requires removal actions "to avoid wasteful, repetitive, short-term actions that do not contribute to the efficient, cost-effective performance of a long-term remedial action" (USEPA 1993). Thus, the purpose or the proposed action includes maximizing the proposed action's contribution to the efficient, cost-effective performance of the long-term remedial action of the overall Portland Harbor Superfund Site.

Terminal 4 is an active marine terminal. The Port's maritime strategic objective is to serve the regional and national importers, exporters, and consumers by enhancing the Portland area's role as a cost-competitive gateway for bulk cargo and automobiles and improve Portland's niche as a regional container and general cargo port. The Port's long-range goal is to promote regional economic vitality in an environmentally sustainable fashion. Terminal 4 is integral to achieving these objectives. Thus, the Removal Action must achieve

the RAOs in a manner that is consistent with the maritime uses at Terminal 4 and minimize the disruption to tenant operations during implementation of the Removal Action.

In summary, the purpose of the proposed action is to remediate contaminated sediments in the Removal Action Area consistent with the RAOs in a manner supportive of the overall cleanup of the Portland Harbor Superfund Site and consistent with the current and future maritime uses at Terminal 4.

2.2 Removal Action Activities Requiring Compensatory Mitigation and Impact Minimization Measures

2.2.1 Activities Requiring Compensatory Mitigation

Components of the Removal Action, including discharge of fill materials for capping and for the CDF result in a requirement for USEPA to evaluate the action based on guidelines in the CWA Section 404(b)(1) (40 CFR 230 [2001]). A draft of this analysis was completed by USEPA and the Port as a supplement to the EE/CA in May 2005. The results of the analysis identified that 15.3 acres of aquatic habitat will be lost in Slip 1 from construction of the CDF. Of the 15.3 total acres of aquatic habitat, only 0.95 acres, or approximately 6 percent of the total aquatic habitat, is in the less than 6 foot depth range (see Section 3.1 for a further explanation of the importance of this depth stratum). Within this 0.95 acres of less than 6-feet deep shallow water habitat, over 85 percent is either steep sloped, armored with large riprap, and/or covered with overwater structures such as a pier apron.

A total of 2.08 acres is within the 6 to 20 foot depth stratum, which represents about 14 percent of the total aquatic habitat impacted in Slip 1. Within this 2.08-acre area, there is a similar trend whereby approximately 85 percent of the 2.08 acres is either steep sloped, armored with large riprap, and/or covered with overwater structures. A total of approximately 10.7 acres, or about 70 percent of the total aquatic habitat impacted at Terminal 4 is in the greater than 20 foot depth range, which is deeper than the preferred habitat of juvenile salmonids (see Section 3.1).

In addition, temporary disturbance to aquatic habitats at Terminal 4 will occur through sediment removal (i.e., dredging) and cover (i.e., capping). Clean substrates will be placed over 5.1 acres as part of the proposed capping, and 10.2 acres of contaminated sediments will be removed from Slip 3 (Figure 2). Both of these activities will temporarily impact the existing benthic invertebrate communities. However, based on studies completed in the Columbia River estuary, the capping and dredging areas will quickly (within months) recolonize with benthic invertebrates (Morton 1977 and McCabe et al. 1996; both *as cited in* NMFS 2005a) after the Removal Action. The long-term benefit of eliminating chemical contaminants from the biologically active zone of the sediment will mitigate for the temporary impact to the aquatic habitat in the capping and dredging areas. Therefore, in accordance with CWA Section 404(b)(1) provisions, compensatory habitat mitigation is required to replace lost habitat functions at Slip 1 due to construction and filling of the CDF.

2.2.2 Impact Minimization Measures

Removal Action design features will be implemented to minimize the loss of habitat in Slip 1 and the Removal Action Area. The design of the CDF berm, which will be placed across the mouth of Slip 1, includes a habitat bench to be constructed within the less than 6 foot water depth range at a 20 percent slope. This design feature will provide approximately 600 lineal feet (approximately 0.25 acres) of gently sloping shallow water habitat within the less than 6 foot water depth range and will provide a migration corridor through the berth replacement area towards Wheeler Bay. Additionally, piles from Pier 5 in Slip 3 and those associated with the old fire boat in Wheeler Bay will be removed by cutting them off at the mudline as part of the Removal Action. Pile removal will improve substrate conditions and potentially contaminant exposure conditions in these areas of Terminal 4.

Conservation measures identified in the Draft Biological Assessment (Anchor 2006) identify various activities that will be employed during all components of the Removal Action, including capping and dredging. These measures will minimize adverse effects of the Removal Action on listed species and their habitat.

2.3 Process for Identifying Compensatory Mitigation Project(s)

A process for identifying an appropriate mitigation project was described in Appendix Q (Section Q-7.2.1) of the EE/CA (BBL 2005) to help ensure that the Slip 1 lost habitat functions are adequately replaced. Since the EE/CA was completed, more advanced design of the Removal Action has occurred and the Port is following the general steps originally listed in Appendix Q (Draft 404(b)(1) Analysis Memoranda) of the EE/CA for addressing the mitigation needs as follows:

1. Conduct a habitat assessment of the Removal Action Area to refine the characterization of affected habitat provided in Appendix Q of the EE/CA based on the design of the Removal Action by describing the biological and physical characteristics of the habitat in the Removal Action Area.
2. Identify options for proposed mitigation project(s) and determine feasibility of each option. Based on the results of the habitat assessment and input from the resource agencies, the Port has identified and proposed options for mitigation project(s). Regional information on habitat types and site uses were used to identify effective mitigation options.
3. Prepare a Conceptual Mitigation Plan Proposal, which will describe the identified mitigation options and evaluate the feasibility of each option.
4. Identify the mitigation project based on the evaluation of mitigation options. The selected mitigation project will be matched to the anticipated habitat losses. As part of this step, the Port will meet with USEPA and, as appropriate, personnel from state or federal natural resource agencies, tribes, or other stakeholders. During these meetings, the Port will present conceptual details of the potential mitigation projects, including drawings and limited engineering characterization needed to support approval of a preferred project(s). The result of this process will be identification of mitigation actions that are adequate to offset habitat losses due to the Removal Action and approval of a conceptual mitigation project.
5. Prepare Draft Mitigation Plan (60 percent design) once the mitigation project has been identified. The plan will identify the site, mitigation requirements, engineering requirements, and approximate costs. This Draft Mitigation Plan will be submitted to USEPA for review and comment along with the 60 percent design documents for the Removal Action. If the selected project is financial contribution to another

habitat restoration project in the region, the 60 percent design would not be required because that component of the project would be completed by that project's primary sponsor (unless a portion of the Port's contribution was the mitigation design). Should that be the case, the 60 percent design "submittal" would instead focus on the funding approach and mechanisms that could be established to ensure the Port's contribution represents an adequate amount/proportion of the entire restoration project such that the component that is commensurate to the Port's funding is sufficient for mitigation of Terminal 4 habitat impacts.

6. Prepare a Final Mitigation Plan (100 percent design) once the Draft Mitigation Plan has been approved. It is anticipated the Final Mitigation Plan will be submitted along with the 100 percent design documents for the Removal Action. Again, the nature of this 100 percent mitigation design submittal may vary depending on whether the mitigation action is a stand alone Port project, or if the Port is contributing to another project in the region.

This document addresses steps 1 through 3 in the above outlined process. The next section summarizes the habitat assessment performed in the Removal Action Area.

3 HABITAT ASSESSMENT

The first step in the process of selecting a compensatory mitigation project was to conduct a habitat assessment of the Removal Action Area to describe existing habitat conditions that may be impacted by the Removal Action. As part of this effort, a review of existing information related to habitat characteristics important to juvenile salmon was completed. Information on these habitat characteristics was collected and the results were mapped and tabulated, as described in more detail throughout this section. The resulting information was used as the basis for determining the types of mitigation actions to explore to adequately offset habitat losses due to the Removal Action.

The remainder of this section addresses habitat conditions in Slip 1 only, as this is the only area requiring compensatory mitigation for lost aquatic habitat, as described in Section 2.2.

3.1 Habitat Assessment Factors

The habitat assessment focused on requirements of juvenile salmonids that migrate through the Lower Willamette River enroute to the Columbia River estuary and the ocean. The salmon-focus of the assessment and mitigation planning is consistent with criteria defined in USEPA's Action Memo (page 23) and Appendix Q of the EE/CA (page Q-33) (BBL 2005), which states that "the compensatory mitigation plans will include an assessment of how they contribute toward the conservation and recovery of ESA-listed species." Additionally, the salmon-focus is consistent with Oregon Administrative Rules (OAR) 635-415-0010, which states that "Priority for mitigation actions shall be given to habitat for native fish and wildlife species. Mitigation actions for non-native fish and wildlife species may not adversely affect habitat for native fish and wildlife." The salmon focus is based on well-established societal concerns about salmon population maintenance and recovery that have resulted in a wide range of public policy actions to protect the species and their habitats. Another reason for using juvenile salmon habitat requirements as a basis for the habitat assessment and mitigation planning is that the requirements overlap considerably with those of many other native and introduced aquatic species that are societally and/or culturally important. For example, nearshore shallow water habitat is important for rearing of subyearling salmon and it is also the most biologically productive zone of a large river.

This productivity is important in providing a food base for aquatic species throughout the river.

A review of the latest literature from the NMFS and other resource agencies was conducted to identify the habitat characteristics that are important to juvenile salmon. In general, juvenile salmon require a variety of habitat types and features in order to grow and survive to adulthood. Juvenile salmon use habitats in large main-stem river areas similar to the Lower Willamette River for rearing and migration. Juvenile salmon are known to be most abundant where depth is shallow, velocity is low, and substrate particle size is small (e.g., sand and gravel) (Bjornn and Reiser 1991 and Everest and Chapman 1972). In addition, studies have shown that fish move to faster, deeper water as they grow, and that fish use cover as refuge from high velocities and predators.

A variety of physical and biological habitat characteristics were mapped during the habitat assessment, based on the information found in the literature. A list of these characteristics along with the rationale for selection is provided below.

- **Physical Characteristics**
  - **Shallow Water**—Shallow water is important for the growth and survival of juvenile salmon because these areas tend to have low velocities, have a shallow slope, and are close to shoreline riparian areas (Tiffan et al. 2006).
    - **Less than 6 feet of water depth**—This depth stratum is the most important for juvenile salmonid rearing, especially subyearling chinook salmon. A number of studies have shown that salmon fry and fingerlings often remain in water depths between approximately 10 centimeters and 2 meters (6.6 feet) (NMFS 2005b). In a study conducted in the Hanford Reach of the Columbia River, investigators found a majority of the subyearling chinook salmon in water no deeper than 1 meter (3.3 feet) (Tiffan et al. 2006). Juvenile chinook salmon in other river systems have also been found in water less than 1.0 to 1.5 meters (3.3 to 4.95 feet) deep (Everest and Chapman 1972; Hillman et al. 1987; Johnson et al. 1992).
    - **6 to 20 feet of water depth**—This water depth stratum is also important for juvenile salmon for rearing and migration, as juvenile fish are expected to

move to deeper water as they grow. ODFW (2005) found that sites with an average depth between 2.1 and 3.0 meters (7 to 10 feet) had significantly higher catch per unit of effort of chinook salmon than deeper sites. Less than 20 feet of water is characterized by NMFS as shallow water habitat (NMFS 2005a).

- **Substrate**—Fine-grained substrate provides habitat for macroinvertebrates, which are juvenile salmonid prey. Studies have suggested that juvenile salmon prefer smaller substrates such as sand and gravel (Chapman and Bjornn 1969 *as cited in* Healey 1991). In the Lower Willamette River, the Oregon Department of Fish and Wildlife (ODFW 2005) found higher catches of juvenile chinook salmon to be associated with beaches consisting of sand substrates. In addition, Tabor et al. (2006) concluded that juvenile chinook salmon preferred sand/gravel substrate at study sites in Lake Washington.
- **Slope**—Shallow sloped beaches and shallow water areas are known to attract juvenile salmon. In a study conducted in the Hanford reach of the Columbia River (Tiffan et al. 2006), researches found that the presence of subyearling chinook increased with decreasing beach slope (lateral). The most subyearlings were observed in areas with a 10 percent slope and declined significantly when slopes exceeded 30 percent. The investigators suggested that "…the beach slope may be functionally important to subyearlings because it incorporates both depth and distance to shore, which are more common habitat metrics, and describes the general morphology of shoreline rearing habitats. The morphology of the site, such as the proximity to shallow water, is important in shaping water velocity and temperature patterns in shoreline areas and may provide escape cover from predatory fish" (Tiffan et al. 2006).
- **Off-channel or slack water**—Off-channel habitat areas are important for juvenile salmon as these areas provide refuge from main channel velocities and access to quiet, shallow water areas.
- **Presence of shoreline modifications**—Modifications, including overwater structures, steep slopes, riprap armoring, piling, and seawalls, reduce the function of juvenile salmonid habitat. Pier structures and piling in nearshore areas provide habitat suitable for juvenile salmon predator species, such as bass.

Overwater structures and pilings associated with piers are thought to increase habitat for bass species, which prey on juvenile salmonids. Kahler et al. (2000) found that bass species are structurally oriented for both spawning and foraging, and small mouth bass may prefer artificial rather than natural structure for nest sites. Large and small mouth bass will use artificial structures in systems lacking natural structure. Salmonids traveling through shaded areas below overwater structures are unable to detect bass predators due to a lack of sufficient surface light, potentially leading to increased predation. In addition, due to the impact on light availability, overwater structures lead to a decrease in primary production rates. Seawalls alter the velocity and timing of river and stream flows, disconnect rivers and streams from their floodplains, and limit the establishment of native vegetation (City of Portland 2004).

- **Biological Characteristics**
  - **Presence of cover**—Cover including riparian vegetation overhanging the water, in-water cover such as large woody debris (LWD), and in-water vegetation is important for juvenile salmon survival and growth. Cover provides juvenile salmon with areas of refuge from high main channel water velocities and predators. Studies have found that abundant catches of juvenile chinook are associated with cover, including undercut banks, vegetated banks, and in-water vegetation (Hillman et al. 1987 and ODFW 2005). In addition, Tabor et al. (2006) found a significantly higher abundance of juvenile chinook salmon at sites with overhanging vegetation and small woody debris in the Lake Washington basin.
  - **Presence of riparian vegetation**—Mature riparian vegetation provides important habitat functions including shading due to overhanging vegetation that regulates water temperature, terrestrial invertebrate prey delivery to aquatic waters, and complex structure creation for fish predator avoidance as ecosystem processes result in mature vegetation falling into the river system.

3.2 Data Collection Activities

Data collection for the habitat assessment occurred on March 2, 2006. A 19-foot aluminum boat was used to cruise the shoreline with five biologists on-board to collect information in Slip 1 on the characteristics described above. The datasheet used to collect the existing

habitat conditions consisted of a table listing each of the habitat characteristics described in Section 3.1 (Figure 3). As the boat was driven along the shoreline within Slip 1, the biologists divided the area into 10 different segments based on biological and physical habitat characteristics. High resolution aerial photographs were used to record the start and end points for each habitat segment. Habitat information was collected for each segment and photographs were taken to show a typical view of the segment. Datasheets for each segment are provided in Appendix A.

3.3 Synthesis of Collected Information

The information collected during the habitat assessment was mapped and tabulated for presentation of results as described below. Each habitat segment in Slip 1 was placed on a map, which also shows the less than 6 foot and 6 to 20 foot water depth strata relative to a typical water level during peak presence of juvenile salmon. The typical water level was selected as 2.8 feet National Geodetic Vertical Datum (NGVD) based on historical water levels (see analysis in Appendix B) between the months of February and May, which is the period of time when juvenile salmon are most abundant in the Lower Willamette River (i.e., the peak outmigration period) (ODFW 2005; Myers et al. 2003, *as cited in* Willamette Restoration Initiative 2004; Dimick and Merryfield 1945, *as cited in* Willamette Restoration Initiative 2004).

The collected biological and physical habitat features were combined into the following six groups. These grouped characteristics represent the current habitat condition in Slip 1:

- Unarmored beach (greater than 10 percent slope), riparian vegetation, sparse or no in-water cover
- Steep slope or riprap, riparian vegetation, in-water cover
- Steep slope or riprap, riparian vegetation, sparse or no in-water cover
- Steep slope or riprap, sparse or no riparian vegetation, sparse or no in-water cover
- Vertical wall, riparian vegetation, sparse or no in-water cover
- Overwater structure (piers), no riparian vegetation, no in-water cover

3.4 Results

The habitat segments map depicting important shallow water depth strata and location of the CDF berm is shown on Figure 4. Photographs and cross sections through shoreline and shallow water areas were also prepared for each habitat segment and are provided in Appendix C. The habitat segments map shows that there is a very small band of habitat within the less than 6 foot water range and a slightly larger band of habitat within the 6 to 20 foot water depth range in Slip 1.

Acreages of existing habitat for each group of habitat characteristics were calculated by water depth (less than 6 feet, 6 to 20 feet, and greater than 20 feet) and are shown on Table 1. The table is set up such that the group with the most desirable habitat features is at the top and the group with the least desirable habitat features is at the bottom. As shown on the table, only about 15 percent of the total acreage of habitat within the less than 6 foot and 6 to 20 foot depth ranges has the most desirable habitat characteristics found in Slip 1. The desirable habitat characteristics include an unarmored beach with greater than 10 percent slope, riparian vegetation, and sparse or no in-water cover and can be seen by viewing the photographs and cross section for segment 9 on Figures 5 and 6. These figures show that the best existing habitat in Slip 1 consists of a severely eroding bank with a 50 percent slope, small recently planted native riparian vegetation, and sparse in-water cover.

Approximately 85 percent of the total acreage of habitat within the less than 6 foot and 6 to 20 foot depth strata is either steep sloped, armored with large riprap, and/or covered with over-water structure such as a pier apron. The least desirable characteristics include overwater pier structures in segments 4 (Berth 405) and 8 (Berth 408) with no riparian or in-water vegetation. Photographs of the pier structures are shown on Figures 7 and 8. These photographs show that the pier structure in segment 4 is supported by predominantly concrete piles with treated wood fender piles and the pier in segment 8 is supported predominantly by treated wood piles. The remainder of the shoreline habitat in Slip 1 consists of steeply sloped, riprapped or vertical shorelines with and without riparian vegetation and in-water cover. Additionally, all the habitat segments in Slip 1 except segments 1 and 10 were characterized as off-channel habitat, as these areas are located away from the main channel.

3.5 Lost Habitat Features and Functions in Slip 1

Based on the results of the habitat assessment in Slip 1, shallow-water nearshore habitats that are in an alcove off the main channel that juvenile salmon may use for rearing and migration functions will be lost as a result of constructing the CDF in Slip 1. The characteristics of the shallow-water nearshore habitats that will be lost are degraded due to steep slopes, shoreline armoring, lack of extensive riparian vegetation, and lack of in-water cover. Due to the degraded habitat characteristics, the juvenile salmonid rearing and migration functions provided by the existing habitat within Slip 1 are limited. Off-channel shallow water habitat is important for juvenile salmon rearing because it typically consists of vegetated shallow water areas with slower velocities than the main river channel, which is important for rearing and minimizing the amount of energy spent swimming. From a physical perspective, Slip 1 provides off-channel habitat important for rearing; however, the function is limited due to the marine commerce activity within the slip at Berths 405 and 408.

Besides potentially providing habitat for juvenile salmon species, Slip 1 potentially provides habitat for other aquatic species. Other aquatic species that inhabit the lower Willamette River include small mouth bass, Pacific lamprey, common carp, large scale sucker, crayfish, and sculpins (Windward 2004). Vegetated shallows at the head of Slip 1 are not likely to be habitat for mammals such as mink because of its degraded nature and isolation from other habitats.

4 OVERALL MITIGATION APPROACH

The overall approach for 404(b)(1) compensatory mitigation is to adequately replace the habitat functions that will be lost in a manner that is consistent with statutory requirements of the CWA. To the extent practicable, the mitigation will also be consistent with regional mitigation and restoration strategies for the Lower Willamette River. Consistent with discussions with NMFS and USEPA personnel, mitigation options will be identified based on qualitative characterization of habitat functions associated with candidate projects, rather than strict quantification and replacement of existing habitat characteristics in Slip 1 and replacement ratios. Currently, there is no standardized method for quantifying aquatic habitat for mitigation purposes, such as that available for wetland mitigation. Given this approach, the emphasis is to look for opportunities that create and/or restore shallow water and off-channel habitat, since that is a well-established critical habitat function for salmonid production in the Willamette system. So even though the preponderance of lost habitat at Slip 1 is deep water habitat (deeper than 20 feet), the emphasis in identifying suitable mitigation is to target shallow water habitat. The mitigation approach includes working cooperatively with stakeholders, including personnel from state and federal resource agencies, tribes, and local river stewards, to ensure an adequate mitigation project is selected that will replace lost habitat functions.

To date, stakeholder involvement in the process has consisted of a meeting dedicated to discussing potential mitigation options to better understand mitigation issues and habitat functions that are important to the stakeholders, and have follow-up one-on-one meetings, telephone calls, and field trips to further explore the identified mitigation options. In the initial habitat meeting, attendants included representatives from NMFS, Willamette Riverkeepers, Oregon DEQ, Environment International (representing all the tribes except the Confederated Tribes and Bands of the Yakama Indian Nation), and Parametrix (representing USEPA). Minutes from this meeting are provided in Appendix D.

To further guide the selection of a mitigation project, criteria is provided in USEPA's Action Memo and in Appendix Q of the EE/CA (BBL 2005) to ensure that any proposed mitigation options address Lower Willamette River watershed issues. These criteria are repeated in Section 4.1.

4.1 Criteria for Identifying Mitigation Projects

Criteria for identifying mitigation projects were included in USEPA's Action Memo and Appendix Q of the EE/CA. These criteria were based on the Commencement Bay 404 (b)(1) document, which relied upon a framework for the Commencement Bay-wide conservation and recovery strategy presented as part of the of the Simenstad (2000) report. It focused on broad landscape attributes and ecosystem processes (i.e., landscape ecology) that promote juvenile salmon utilization of existing and potential habitats. While the report does not specify or set priorities on discrete actions, it does identify criteria to guide selection of sites and actions. Those criteria were modified to address Lower Willamette River watershed issues and are as follows:

1. All compensatory mitigation must be consistent with the established mitigation strategies, conservation initiatives, or precedence from mitigation projects supported by state and federal resource agencies in the Lower Willamette Basin.
2. Preference will be given to compensatory mitigation plans that are consistent with habitat function.
3. All compensatory mitigation plans will include an assessment of how they contribute to the conservation and recovery of Endangered Species Act (ESA) listed species.
4. Mitigation plans must include consideration for connectivity to existing habitat.
5. All compensatory mitigation plans will include measurable performance objectives, management, monitoring, and reporting requirements; responsibilities; and schedule.
6. Native species only will be utilized in any plantings. The only exception to the use of native species would be for vegetation used as a quick groundcover. In these instances, a sterile species, such as wheat grass, may be used.
7. The potential success/feasibility of a mitigation project will be assessed.

Additionally, as stated in Appendix Q of the EE/CA, preference is that the mitigation project be within the Portland Harbor Superfund Site ISA, on Port property, or on non-Port property to which the Port can reasonably assume access and control. However, projects available through other local agencies, such as the City of Portland or Metro should be considered if projects on Port property are not as viable as other projects.

4.2 Lower Willamette River Mitigation/Restoration Strategies

To ensure the Port's proposed mitigation options are consistent with other regional mitigation/restoration efforts, a literature review of documents related to the topic was conducted. The most relevant information was found in the following key documents:

- Draft Willamette River Subbasin Plan prepared for the Northwest Power and Conservation Council by the Willamette Restoration Initiative (2004)
- City of Portland Watershed Assessment Summary (City of Portland 2004) and related Portland Watershed Management Plan (City of Portland 2005)
- Biology, Behavior, and Resources of Resident and Anadromous Fish in the Lower Willamette River, prepared for the City of Portland by ODFW (2005)

The Draft Willamette Subbasin Plan identified limiting factors in the Lower Willamette River Mainstem for the focal species in the river, including cutthroat trout, winter steelhead, spring chinook salmon, and coho salmon. Limiting factors for these species were determined using Ecosystem Diagnosis and Treatment (EDT) to analyze habitat conditions on a reach-by-reach basis. Limiting factor analyses are used to guide restoration/mitigation strategies within a specific river or stream reach. EDT analysis indicates that the applicable key limiting factors in the Lower Willamette River are habitat diversity and key habitat quantity. Factors that have reduced habitat diversity include loss of shallow water habitat, lack of wood, bank hardening and reconfiguration, and loss of off-channel habitats (Willamette Restoraton Initiative 2004). In addition to habitat diversity and the quality of habitat available in the Lower Willamette River, the quantity of habitat available for key life history stages is also limiting. Lack of off-channel habitat, low levels of wood and shallow-water habitat, and lack of channel and bank complexity all result in a lack of sufficient amounts of key habitat available for migration and rearing stages of chinook, coho, and steelhead using the Lower Willamette River (Willamette Restoration Initiative 2004). Based on these limiting factors, recommended aquatic habitat restoration actions include increasing habitat complexity and key habitat quantity by increasing the amount of shallow-water and off-channel habitat, increasing the amount of floodplain habitat accessible to the river, and increasing the number of large pieces and densities of wood (Appendix J of the Draft Willamette Subbasin Plan).

The City of Portland Watershed Assessment Summary (2004) identifies restoration and protection opportunities in the Lower Willamette River in Portland. Identified restoration opportunities for the City include increasing the amount of shallow water habitat, improving stormwater quality, recharging the groundwater to reduce stormwater impacts, continuing with the revegetation program, and working with the U.S. Army Corps of Engineers to influence the way upstream flood control and hydropower dams are operated to improve changes in seasonal flow patterns. Identified protection opportunities include protecting remaining natural riparian areas, such as Powers Marine, Sellwood, Willamette, Oaks Bottom, Cathedral, and Kelley Point parks. Stephens Creek was identified as an important area to protect and restore as its confluence with the Willamette River just north of the Sellwood Bridge provides important habitat and has been affected by urbanization. Similarly, although the lower reaches are blocked by culverts, the upper reaches of Balch, Saltzman, Doane, and Miller Creeks, along with several unnamed streams in Forest Park are protected from development by their location within the park. These areas provide the important benefit of adding clean, cool water to the Willamette River for fish refuge, despite the fish passage issues.

ODFW conducted a series of studies between 2000 and 2004 to evaluate aquatic habitat and biotic communities in the Lower Willamette River, and provide guidance for protecting species of threatened and endangered salmonids. The only recommendation from this research related to restoring habitat in the Lower Willamette River was an evaluation of options for restoring beach habitat functions and processes to determine the feasibility of restoring or creating beach habitats. Although the studies found salmonids exhibited no clear preferences for any habitat type, beaches were important to subyearling fish, and catches of larger juvenile fish were positively correlated with small substrates (sand), shallow water, and vegetated banks (ODFW 2005).

Other documents that were reviewed as part of this exercise, but did not contribute any new information on specific restoration/mitigation actions for aquatic habitat in the Lower Willamette River included:

- Revised Viability Criteria for Salmon and Steelhead in the Willamette and Lower Columbia Basins (Review Draft) (Willamette/Lower Columbia Technical Recovery Team and ODFW 2006)
- Draft Willamette Watershed Characterization Report (City of Portland Bureau of Environmental Services 2004)
- Willamette Basin Alternative Futures Analysis (Pacific Northwest Ecosystem Research Consortium 2002)
- Willamette River Basin Planning Atlas – Trajectories of Environmental and Ecological Change (Pacific Northwest Ecosystem Research Consortium 2003)

Based on the information described above and the results of the literature review of habitat characteristics important to juvenile salmon (Section 3.1), mitigation actions should consider the following:

- Develop gradually-sloped sand and gravel beach areas with shallow water (less than 6 feet and 6 to 20 feet) habitat
- Provide features to increase habitat complexity, including overhanging riparian vegetation, LWD, and in-water vegetation
- Improve water quality characteristics
- Consider habitat connectivity, especially for juvenile salmon migration corridors
- Develop off-channel or backwater habitat with low current velocity

5 MITIGATION OPTIONS AND FEASIBILITY

This section describes the mitigation options that are under evaluation by the Port. The following sections present the conceptual basis for mitigation projects at various sites in the Lower Willamette River. The potential size and extent of some of the listed projects exceed the likely mitigation obligations resulting from the Removal Action. Therefore, the Port would contribute to completion of the projects, either by providing land, funding, or in-kind services (e.g., design or permitting support). Additional support from other parties would be necessary to complete the projects. In recent discussions, agency personnel have indicated that such arrangements could be acceptable to meet the 404(b)(1) mitigation requirements.

5.1 Swan Island Project Site

5.1.1 Rationale for Choice of Site

The Swan Island Project site was chosen because of the opportunity to provide connectivity, the accessibility of the land, the location of the site within the Portland Harbor Superfund Site study area, the ability to construct new shallow water habitat out of existing upland habitat, and Port ownership of the property.

The site is within an approximately 1-mile section of shoreline property that the Port owns along the Willamette River between River Mile (RM) 8 and 10. The project location consists of a 700 to 800-foot section in the middle portion of Swan Island (Figure 9). This area of the river does not currently contain any Port or joint Port-City of Portland habitat enhancement or mitigation projects (Figure 10), so completing a project in this area would provide habitat in an area that currently has limited habitat available for juvenile salmonids. This site is within an approximately 1-mile section of shoreline property that the Port owns and controls. Other sections of this reach provide opportunities to improve habitat, potentially creating one of the longest contiguous reaches of improved habitat in the Portland Harbor. The City of Portland also has identified restoration plans for beach area adjacent to the Swan Island Combined Sewer Outfall (CSO) Pump Station. This area is at the upstream end of the 1-mile stretch that the Port owns and provides an additional opportunity to improve habitat along this section of the river.

Lastly, consistent with Appendix Q of the EE/CA (Section Q-7.2.1, BBL 2005), the Swan Island site is on Port property and is located within the Portland Harbor Superfund Site study area. Since the Port owns the Swan Island site property, access to the site for construction, long-term monitoring, and adaptive management activities is guaranteed.

5.1.2 Proposed Action

The proposed action at the Swan Island site is to layback the shoreline along 700 to 800 feet of the parcel to create a more gently sloping beach and increase the amount of shallow water habitat (Figure 11). The new beach would gently slope (25 percent, 4:1 horizontal to vertical) down to a sand flat area. New shallow-water area would be created between +2.8 feet NGVD and -3.2 feet NGVD. The sand flat area would be placed such that the area is inundated with water throughout the year and with 6 feet or less of water during the peak juvenile salmon out-migration time (February to May). Also proposed for this site is planting of riparian vegetation and placement of in-water LWD and other structures as appropriate (e.g., protective berm) to provide more habitat complexity in terms of low velocity refugia areas within the shallow water, and to protect the area from boat wakes and create calm waters.

5.1.2.1 Benefit to Salmon

This project proposes to restore shoreline habitat and improve its function along a section of Swan Island shoreline by creating shallow water habitat and increasing habitat complexity. Specifically, the proposed project would provide increased shallow water beach habitat with complex features including in-water LWD and riparian vegetation along a 700 to 800 foot section of Swan Island in the Lower Willamette River, resulting in approximately 1.2 acres of new shallow-water aquatic habitat. This would restore the type of habitat consistent with the limiting factor (habitat diversity) identified for spring chinook salmon, coho salmon, cutthroat trout, and winter steelhead in the Lower Willamette River in the Draft Willamette Subbasin Plan (Willamette Restoration Initiative 2004).

The shallow water habitat would be constructed at an elevation to provide less than 6 feet of water depth during the peak juvenile salmon outmigration period between

February and May. As discussed in Section 3.1, studies have shown that juvenile salmon, particularly subyearling chinook salmon, prefer water depths of 6 feet or less. These areas provide calm waters where fish can rest and feed. The in-water LWD will provide cover and hiding areas for juvenile fish to escape aquatic and avian predators.

5.1.2.2 Benefit to Other Aquatic Species

As presented in Section 3.5, shallow, nearshore areas with slack water conditions may also provide habitat for a number of aquatic species other than salmon, including smallmouth bass, Pacific lamprey ammocoetes, common carp, large scale sucker, crayfish, mink, and amphibians. Shallow water areas are also among the most productive in large river systems and, therefore, important sources of food to the local ecosystem. The proposed creation of shallow water habitat and increase in habitat complexity will also provide improved habitat conditions for aquatic species.

5.1.2.3 Connectivity

As described in Section 5.1.1, this proposed project location is along an approximately 1-mile section of shoreline property that is owned by the Port, so there is an opportunity to expand the proposed project area along the entire 1-mile stretch through future restoration actions. In addition, the City of Portland has also identified the area at the upstream edge of the 1-mile stretch of shoreline for restoration in association with the construction of the Swan Island CSO Pump Station.

5.1.3 Proposed Project Feasibility

5.1.3.1 Access to Property

The Port owns the property and the aquatic lands, so access to the site for construction, monitoring, and adaptive management purposes is guaranteed.

5.1.3.2 Property Ownership

The Port owns the property and the aquatic lands and it is currently available for use as a mitigation project.

5.1.3.3 Administrative Logistics

Since the Port owns the property and there would be no other funding participants, arranging funding is not expected to be an obstacle for this project.

5.1.3.4 Status and Timing of Proposed Project

A conceptual design of the proposed project has been prepared and if this mitigation option is selected, the design process would continue. Construction on this project would occur during the construction of the Removal Action between July 2007 and October 2010.

5.1.3.5 Other Considerations

At the Agency Habitat Meeting on June 12, 2006, agency personnel expressed concern that the site is in an area of relatively high current velocity, and may not offer off-channel habitat preferred by agency for mitigation projects.

Fisheries biologists involved in the conceptual project design had recognized these potential attributes and qualitatively evaluated the flow conditions near shore in this area. The evaluation indicated that current velocity near shore in the project location was substantially slower than channel currents, and the proposed project would create approximately 1.2 acres of essentially slack-water, shallow habitat. These conditions extend for approximately 1 mile upstream of the project area, including an extensive beach area at approximately RM 9.8 to 10. If necessary, the Port would provide more quantitative characterization of potential flow characteristics.

5.2 Project-Specific Financial Contribution—Ramsey Lake Refugia Project, Phase II

5.2.1 Rationale for Choice of Site

The Ramsey Lake site was chosen by the City of Portland based on monitoring results for the Ramsey Lake Refugia Project, Phase I, which showed use by ESA-listed salmon species.

5.2.2 Proposed Action

For this option, the Port would make a financial contribution to the City of Portland, as the Ramsey Lake Refugia Project, Phase II is in need of additional funding. The Port would not fund the entire project, just a portion of it. A full project description developed by Ry Thompson, Project Manager, City of Portland Environmental Services, is provided below for evaluation purposes (Thompson 2006).

This project proposes to restore the Ramsey Wetland Complex (located in the Columbia Slough) by re-establishing hydrologic connectivity to the Lower Columbia Slough to improve floodplain wetland functions and to increase the amount and quality of off-channel rearing and refuge habitat for ESA-listed juvenile chinook, coho, and steelhead.

A specific design for this project has not been selected, but conceptual design drawings for three alternatives were developed in early June 2006. The three options being considered are described below and are shown on Figure 12. The City of Portland's preferred alternative is Concept B.

- Concept A—Backwater Wetland and Channel. This concept includes excavating an alcove and connecting it to a small isolated wetland.
- Concept B—Backwater Wetland and Connected High-flow Channel. This concept includes excavating two alcoves and connecting them through positively draining high-flow channels.
- Concept C—Floodplain Wetland and Graded Banks. This concept includes laying back and grading the banks from the Lower Columbia Slough and providing more frequent inundation of the floodplain.

All three project concepts include restoring and revegetating 5 acres of land. All concepts include the placement of anchored LWD for habitat complexity and cover.

5.2.2.1 Benefit to Salmon

The proposed project will re-establish hydrologic connectivity to the Lower Columbia Slough to reclaim and improve floodplain wetland functions (forested wetland and soft bottom, mud backwater sloughs) and to increase the amount and

quality of off-channel rearing and refuge habitat for juvenile chinook, coho, and steelhead. Loss of tidally influenced, floodplain wetland habitats have been identified as a limiting factor for Columbia and Willamette River basin salmon. This project will incrementally return 5.0 acres of this lost habitat, thus helping to achieve restoration goals identified by regional resource managers. (Thompson 2006)

5.2.2.2 Benefit to Other Aquatic Species

The creation of shallow water habitat will provide habitat for other aquatic species, including small mouth bass, Pacific lamprey ammocoetes, common carp, large scale sucker, and crayfish. Shallow water areas are also among the most productive in large river systems and, therefore, important sources of food to the local ecosystem. In addition creation of floodplain wetland habitat will provide features important to mink and amphibians.

5.2.2.3 Connectivity

The proposed project is a second phase of the Ramsey Lake Refugia Project, which will extend the habitat restoration already completed to a new portion of Ramsey Lake. In addition, there have been a number of restoration/enhancement activities completed throughout the Columbia Slough and this project will complement those projects.

5.2.3 Proposed Project Feasibility

5.2.3.1 Access to Property

The City of Portland has access to the site.

5.2.3.2 Property Ownership

The City of Portland owns this site and it is available for a habitat restoration/mitigation project.

5.2.3.3 Administrative Logistics

The payment to the City of Portland to fund a portion of the Ramsey Lake Refugia, Phase II project would be similar to an in-lieu-fee payment consistent with the Clean

Water Act 404 regulations and guidance for compensatory mitigation[1]. Since all other aspects of access have been addressed for the initial project phase, logistical barriers to completing this project appear to be minimal.

5.2.3.4 Status and Timing of Proposed Project

Conceptual design drawings for this project were developed for the City of Portland in early June 2006 and more extensive design is expected to begin in summer 2006. Construction is expected to occur in summer 2008.

5.3 Project-Specific Mitigation Bank—Miller Creek Site

5.3.1 Rationale for Choice of Site

The Miller Creek site is located in Multnomah Channel close to the confluence with the Willamette River within the Portland Harbor Superfund Site study area. This site was chosen as a potential restoration/mitigation area because the watershed of Miller Creek is protected in Forest Park, and the creek provides a source of clean, cool water to Multnomah Channel. Culvert replacement work was recently completed as part of an Oregon Department of Transportation (ODOT) mitigation project and monitoring has indicated the presence of coho salmon in the creek.

5.3.2 Proposed Action

The proposed action for this mitigation option is to restore the mouth of Miller Creek by rerouting the existing mouth of Miller Creek from flowing into the marina basin to meandering through forested floodplain habitat and discharging into Multnomah Channel to the east of the marina. This would be accomplished by constructing a new channel and excavating material from the floodplain area. In addition, a culvert would be installed on a smaller stream coming off of Forest Park adjacent to Miller Creek to

[1] See "Federal Guidance for the Establishment, Use and Operation of Mitigation Banks," 60 FR 58605 (Nov. 1995) http://www.epa.gov/owow/wetlands/guidance/mitbankn.html; "Federal Guidance on the Use of In-Lieu-Fee Arrangements for Compensatory Mitigation under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act," (October 2000), http://www.epa.gov/owow/wetlands/pdf/inlieufee.pdf.

reestablish connectivity to the existing floodplain area. A conceptual plan view of the proposed action is shown on Figure 13.

For this option, the Port would contribute money to a project specific mitigation bank that would be administered by a separate entity.

5.3.2.1 Benefit to Salmon

The proposed project would increase the amount of off-channel or shallow water and floodplain habitats, which would increase lost habitat types that were identified as limiting factors for chinook, coho, steelhead, and cutthroat trout (Willamette Restoration Initiative 2004).

5.3.2.2 Benefit to Other Aquatic Species

Similar to the benefits identified for the Ramsey Lake Refugia, Phase II project, the creation of shallow water habitat will provide habitat for other species that may be displaced from Slip 1 by the construction of the CDF, including small mouth bass, Pacific lamprey ammocoetes, common carp, large scale sucker, and crayfish. Shallow water areas are also among the most productive in large river systems and, therefore, important sources of food to the local ecosystem. In addition creation of floodplain wetland habitat will provide features important to mink and amphibians.

5.3.2.3 Connectivity

The proposed project would provide connectivity to upstream portions of the creek that were restored as part of a separate mitigation effort.

5.3.3 Proposed Project Feasibility

5.3.3.1 Access to Property

Access to the parcel of property where the proposed action would occur will have to be coordinated through the land owner, Frevach Land Company. Initial contact with an owner representative indicated the property owner may be willing to cooperate.

5.3.3.2 Property Ownership

The property is owned by Frevach Land Company. It is unclear whether the land is available for the proposed action. An agreement between the property owner and the mitigation bank will need to be reached prior to implementing any actions.

5.3.3.3 Administrative Logistics

Although informal discussions seem positive, formal agreement on access to the site has not been obtained. In addition, the details of the project-specific mitigation bank have not been determined for this site, nor has the portion of the project that would be funded by the Port. An overall responsible party needs to be identified to be guardian of the bank and ensure the proposed project is implemented. The mitigation bank would be established based on federal guidance on the establishment of mitigation banks under the Clean Water Act Section 404 (USEPA 1995). Although these issues are surmountable, they are currently barriers to feasibility and implementation of projects at the Miller Creek site.

5.3.3.4 Status and Timing of Proposed Project

Conceptual design plans are in process. The timing of the proposed action is unclear at this point.

6 SUMMARY OF MITIGATION OPTIONS AND NEXT STEPS

Table 2 provides a summary of the proposed mitigation options and their consistency with project selection criteria (Section 4.1) and project feasibility. As shown in the table, all of the proposed options provide benefits to ESA-listed species that will contribute towards the recovery of those species (selection criterion number 3). Projects that address the most limiting factors identified for the Lower Willamette River include the Ramsey Lake Refugia Phase II and Miller Creek projects. To varying degrees, all of the proposed projects are consistent with most of the mitigation selection criteria. The Swan Island and Miller Creek projects are located within the Portland Harbor Superfund Site study area. Because planning for the Miller Creek project has not begun, and because of issues associated with land ownership and access, this candidate project has the most significant potential logistical barriers related to feasibility. The Swan Island project has no such barriers because it is owned and controlled by the Port. The Ramsey Lake Refugia, Phase II project has what appears to be one relatively minor feasibility issue related to defining a legal vehicle for contribution of funding.

Based on the consistency of each project option with selection criteria and the project feasibility evaluation summarized above and in Table 2, a mitigation project will be selected by the Port in consultation with USEPA, tribal representatives, and the appropriate resource agencies. This determination will be made by the following process, as described in Section 2.3:

- The Port will meet with USEPA and, as appropriate, personnel from state or federal natural resource agencies, tribes, or other stakeholders. During these meetings, the Port will present conceptual details of the mitigation project, including drawings and limited engineering characterization needed to support approval of the project. The result of this process will be identification of mitigation actions that are adequate to offset habitat losses due to the Removal Action and approval of a conceptual mitigation project.

7 REFERENCE

Anchor Environmental, LLC (Anchor). 2006. Draft Biological Assessment, Terminal 4 Early Action Project, Port of Portland, Portland, Oregon. August 9 2006.

Blasland, Bouck, & Lee, Inc. (BBL). 2004a. Work Plan, Terminal 4 Early Action Engineering Evaluation/Cost Analysis, Port of Portland, Portland, Oregon. February 23.

BBL. 2004b. Characterization Report, Terminal 4 Early Action Engineering Evaluation/Cost Analysis, Port of Portland, Portland, Oregon. September 17.

BBL. 2005. Terminal 4 Early Action Engineering Evaluation/Cost Analysis, Public Review Draft, Appendix Q—Draft Clean Water Act Section 404(b)(1) Analysis Memorandum, Port of Portland, Portland Oregon.

Bjornn, T.C. and D.W. Reiser. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. Pages 83-138 in W.R. Meehan editor. Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society, Special Publication 19, Bethesda, Maryland.

City of Portland Bureau of Environmental Services. 2004. Draft Willamette Watershed Characterization Report.

City of Portland. 2004. Watershed Assessment Summary. http://www.portlandonline.com/fish/index.cfm?c=dgecd.

City of Portland. 2005. Portland Watershed Management Plan.

Code of Federal Regulations (CFR) 40 CFR 230 2001.

Everest, F.H. and D.W. Chapman. 1972. Habitat Selection and Spatial Interaction by Juvenile Chinook Salmon and Steelhead Trout in two Idaho Streams. Journal of the Fisheries Research Board of Canada 29:91-100.

Healey, M.C. 1991. Life-history of Chinook salmon (Oncorhynchus tshawytscha). In C. Groot and L. Margolis (eds), Pacific salmon life histories, p. 311-393. University of British Columbia Press, Vancouver, Canada.

Hillman, T.W., J.S. Griffith, and W.S. Platts. 1987. Summer and Winter Habitat Selection by Juvenile Chinook Salmon in a Highly Sedimented Idaho Stream. Transactions of the American Fisheries Society 116:185-195.

Johnson, S.W., J.F. Thedinga, and K.V. Koski. 1992. Life History of Juvenile Ocean-type Chinook Salmon (Oncorhynchus tshawytscha) in the Situk River, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 49:2621-2629.

Kahler, T., M. Grassley, and D. Beauchamp. 2000. A summary of the effects of bulkheads, piers, and other artificial structures and shorezone development on ESA-listed salmonids in lakes. Utilities Department, City of Bellevue, Washington.

National Marine Fisheries Service (NMFS). 2005a. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Northwest Aggregate Sand and Instream Gravel Mining, Lower Columbia River, Multnomah County, Oregon. NMFS Number 2005/03522, December 27, 2005.

NMFS. 2005b. Salmon at River's End: The Role of the Estuary in the Decline and Recovery of Columbia River Salmon. NOAA Technical Memorandum NMFS-NWFSC-68. August 2005.

Oregon Administrative Rules (OAR). 635-415-0010—Fish and Wildlife Habitat Mitigation Policy. Oregon Department of Fish and Wildlife.

Oregon Department of Fish and Wildlife (ODFW). 2005. Biology, Behavior, and Resources of Resident and Anadromous Fish in the Lower Willamette River, Final Report of Research,

2000-2004. Edited by Thomas Friesen, ODFW. Prepared for City of Portland Bureau of Environmental Services, Endangered Species Act Program.

Pacific Northwest Ecosystem Research Consortium. 2002. Willamette Basin Alternative Futures Analysis.

Pacific Northwest Ecosystem Research Consortium. 2003. Willamette River Basin Planning Atlas—Trajectories of Environmental and Ecological Change. Edited by David Hulse, Stan Gregory, and Joan Baker for the Pacific Northwest Ecosystem Research Consortium. OSU Press, Corvallis, OR.

Simenstad, C.A. 2000. Draft Commencement Bay aquatic ecosystem assessment: ecosystem scale restoration for juvenile salmon recovery. Published for: City of Tacoma, Washington Department of Natural Resources, and U.S. Environmental Protection Agency. 41 pp.

Tabor, R.A., H.A. Gearns, C.M. McCoy, III, and S. Camacho. Nearshore Habitat Use by Juvenile Chinook Salmon in Lentic Systems of the Lake Washington Basin, Annual Report, 2003 and 2004. Prepared by U.S. Fish and Wildlife Service. Funded by Seattle Public Utilities (City of Seattle) and the City of Mercer Island.

Thompson, Ry. 2006. Personal communication from Ry Thompson, Project Manager, City of Portland Environmental Services, with Tom Schadt of Anchor Environmental, L.L.C.

Tiffan, K.F., L.O. Clark, R.D. Garland, and D.W. Rondorf. 2006. Variables Influencing the Presence of Subyearling Fall Chinook Salmon in Shoreline Habitats of the Hanford Reach, Columbia River. North American Journal of Fisheries Management 26:351-360, 2006.

U.S. Environmental Protection Agency (USEPA). 1993. Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA. EPA540-R-93-057. August.

USEPA. 1995. Federal Guidance for the Establishment, Use and Operation of Mitigation Banks, 60 FR 58605 (November 1995) http://www.epa.gov/owow/wetlands/guidance/mitbankn.html.

USEPA. 2000a. NPL Site Narrative for the Portland Harbor. http://www.epa.gov/superfund/sites/npl/nar1606.htm

USEPA. 2000b. Federal Guidance on the Use of In-Lieu-Fee Arrangements for Compensatory Mitigation under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, October 2000, http://www.epa.gov/owow/wetlands/pdf/inlieufee.pdf.

USEPA. 2001. Administrative Order on Consent for Remedial Investigation/Feasibility Study, U.S. EPA Docket Number CERCLA-10-2001-0240.

USEPA. 2003. Administrative Order on Consent for Removal Action in the Matter of Portland Harbor Superfund Site, Terminal 4, Removal Action Area, Portland, Oregon.

USEPA. 2006. Action Memorandum for a Removal Action at the Port of Portland Terminal 4 site within the Portland Harbor Superfund Site, Portland, Multnomah County, Oregon, May 11, 2006.

Willamette/Lower Columbia Technical Recovery Team and ODFW. 2006. Revised Viability Criteria for Salmon and Steelhead in the Willamette and Lower Columbia Basins. Review Draft, April 2006.

Willamette Restoration Initiative. 2004. Draft Willamette Subbasin Plan. Prepared for The Northwest Power and Conservation Council by the Willamette Restoration Initiative. May 28, 2004.

Windward Environmental, LLC. 2004. Portland Harbor RI/FS Programmatic Work Plan Appendix B: Ecological Risk Assessment Approach. Prepared for the Lower Willamette Group, April 23, 2004.